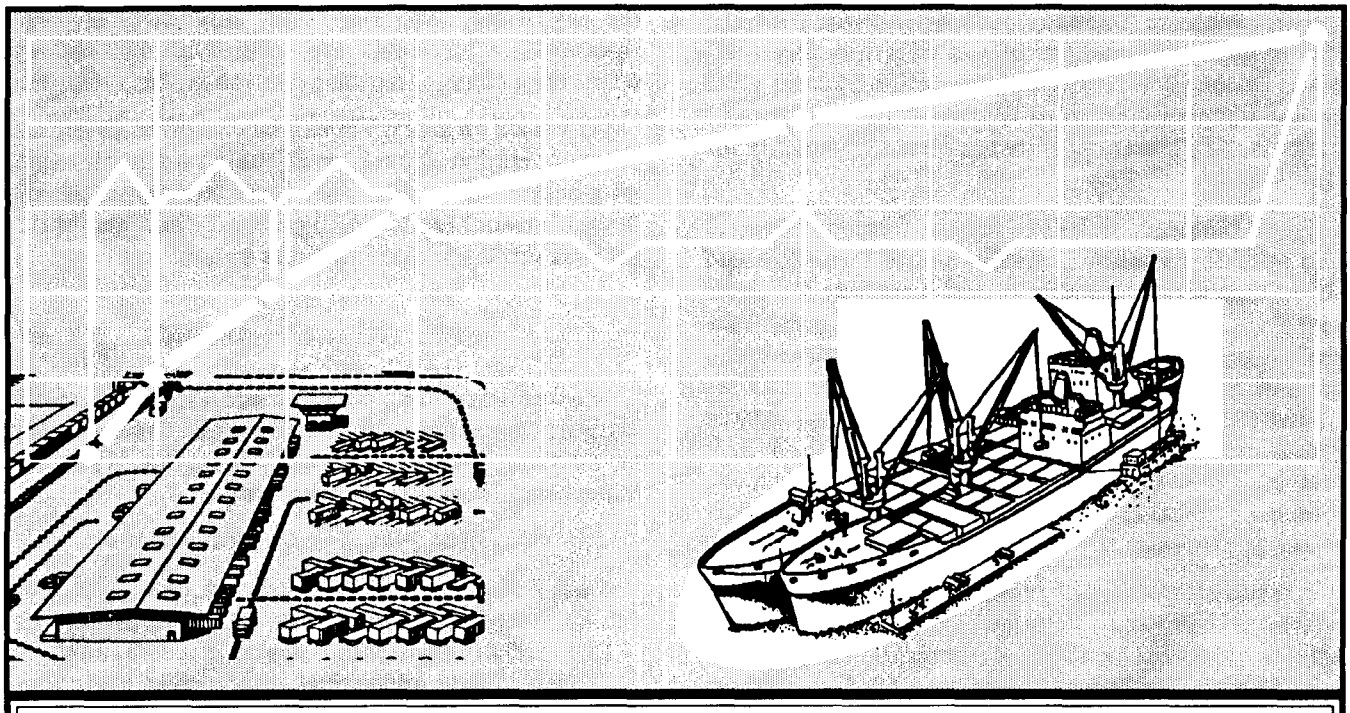

CHAPTER 5

INLAND WATERWAY OPERATIONS

This chapter implements QSTAG 692.

INTRODUCTION

Inland waterways include all rivers, lakes, inland channels, canals deep enough for waterborne traffic, and protected tidal waters. In a TO, an inland waterway is normally operated as a complete system. It includes the locks, dams, bridges, and other structures that contribute to or effect movement of vessels carrying passengers and freight. Inland waterways are mainly used for the civilian economy. Military use depends on the degree of waterway development, necessary rehabilitation, tactical situation, and the impact military use of the waterway will have on the civilian economy. It is an extremely efficient method for moving liquid, bulk, or heavy or outsized cargo where there is an abundance of navigable rivers and canals and lack of good and/or available roads and railroads.

QSTAG 592 (see Appendix B) standardizes documents common to several means of transport. This agreement helps the terminal operators predict movement requirements.

INLAND WATERWAY SYSTEM

The US Army Corps of Engineers operates and maintains the IWWS in a generic theater or in CONUS. In overseas theaters that have developed IWWSs, the HN operates and maintains them. The US Army's use of the system must be granted by the HN. Once the HN has approved integration of the US Army into its IWWS, equipment requirements, including equipment allocated by the HN, must be determined.

Three separate functional components (the ORP, the inland waterway, and the inland waterway terminal) make up the IWWS. The transportation planner must estimate the capacity of each of these functional components. The lesser capacity becomes the capacity for the IWWS.

When required, an IWWS may be formed to control and operate a waterway system and to formulate and coordinate plans for using inland waterway transport resources. It may also be formed to provide for integrating and supervising local civilian facilities used to support military operations. Depending on the requirements, this operational organization may vary in size from a single barge crew to a complete IWWS. It may consist entirely of military personnel or may be manned by local civilians supervised by military units of the appropriate transportation staff section.

A terminal group may operate an IWWS. However, a terminal battalion composed of appropriate terminal service, terminal transfer, harborcraft, boat, and/or amphibian units is most often employed in this capacity. Figure 5-1 shows a typical inland waterway organization.

INLAND WATERWAY TERMINAL

An IWWT normally includes facilities for mooring, cargo loading and unloading, dispatch and control, and repair and service of all craft that can navigate the waterway. Terminals either exist or are established at the origin and terminus of the inland water route. Intermediate terminals are located along the way, wherever a change in transportation mode is required.

Terminals on an IWWS can be classified as general cargo, container, liquid, or dry bulk commodity shipping points. Terminals of the three latter types usually include special loading and discharge equipment that permits rapid handling of great volumes of cargo.

OPERATIONAL PLANNING

The transportation planner is interested in an inland waterway's capability to move cargo. Consequently, he is interested in the affect of the waterway's physical features on its ability to carry cargo.

Physical Planning Considerations

Among the physical features that determine what can be moved over a waterway are the following:

- ❑ Restricting width and depth of the channel.
- ❑ Horizontal and vertical clearance of bridges.
- ❑ Number of locks, their method of operation, and the length of time required for craft to clear them.

Freeze-ups, floods, and droughts also affect a waterway's capacity. The transportation planner must know when to expect these seasonal restrictions and how long they can be expected to last. He is concerned with speed, fluctuation, and direction of water current; as well as the availability of craft, labor, terminal facilities, and maintenance support.

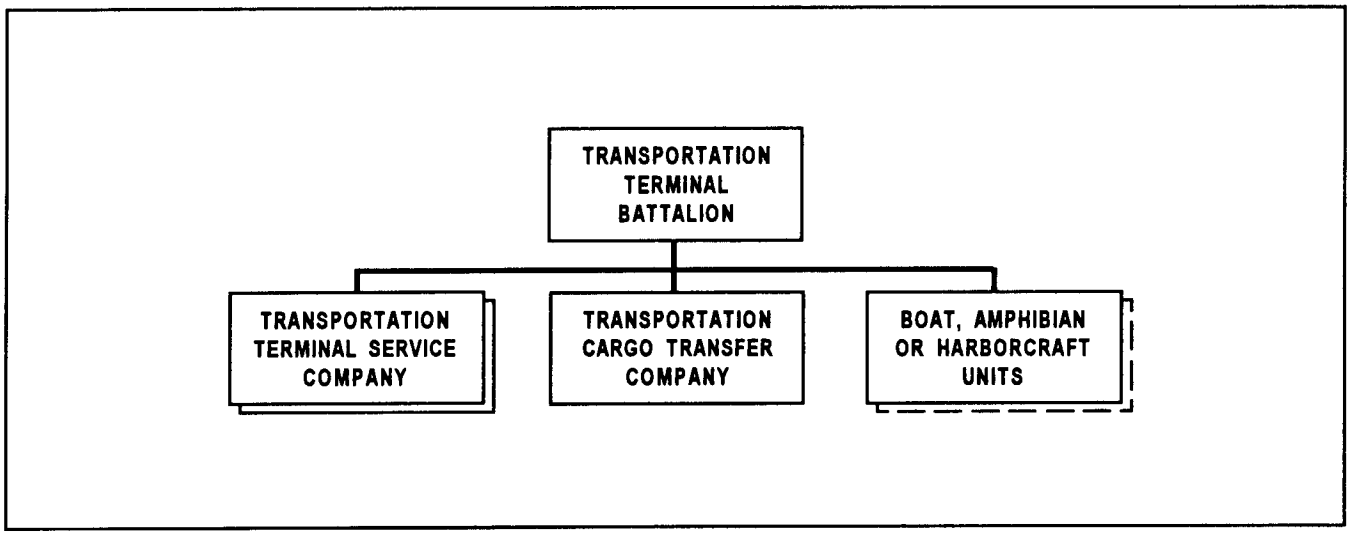

Figure 5-1. Sample organization for IWWS

Seldom are enough craft or barges available to fill or exceed the capacity of an inland waterway. However, if there are enough, the daily capacity can be estimated. This is done by determining the number of craft per day that can be passed through the most limiting restriction, such as a lock, lift bridge, or narrow channel. This will give a passage capability. Deduct the civilian passages and that leaves the passages allowed the military. (A percentage may be allowed instead.)

Turnaround time is the length of time between leaving and returning to a point. Since barges are being picked up at a wharf or stake barge, barge loading time is not part of the computation. If barges are picked up at shipside without marshaling at a wharf or stake barge, loading time of the barge would become a factor of turnaround time. The paragraphs below discuss items that must be known to calculate turnaround time.

- ❑ Length of haul is the round-trip distance between the barge pickup point and barge delivery points.
- ❑ Speed is influenced by the wind, current, power of craft, and size of load. If the craft's speed cannot be determined, assume it is 4 miles per hour in still water (6.4 kilometers per hour). Speed and direction of current can frequently be discounted since resistance in one direction may be balanced by assistance in the other direction. However, this is not always the case.
- ❑ Loading and unloading time is the time to load and unload a craft at origin and destination.
- ❑ Time consumed in the locks is the time taken by a craft and its tow to pass through a lock. When exact data is lacking, lock time is assumed to be 1 hour per single lock.
- ❑ Planned hours of operation per day is usually 20. Dropping barges from the tow, refueling, taking on stores, rigging up, and maintenance consume the remaining 4 hours.
- ❑ Transit time is the time to move the craft the length of the haul and return to its origin. Transit time equals the distance divided by the speed of the craft. It does not include stops or delays of any kind. Due to possible damage to the inland waterway, a speed control may be in force. To determine transit time, add the following:
  - The time to make up the tow.
  - The distance divided by the speed of the tow.
  - The time consumed passing through the locks.
  - The time to break up the tow.

When determining the number of barges, tugboats, or craft required, always round up to the nearest whole number, then apply maintenance factor and round up again.

The most current type of barge employed is when LASH and SEABEE type ships are used. These ships furnish preloaded barges. Therefore, the barges used on the IWWS are furnished by the ship schedules. On an inland waterway, one of two possible situations will determine the method for calculating the waterway capacity.

Required information is needed for planning for turnaround times and equipment requirements when employing barge-carrying ships. Table 5-1 (page 5-4), contains criteria for determining planning and equipment requirements for barge-earring ships.

Required information is needed when barge-carrying ships are not in use and ship's cargoes are discharged onto barges at the ORP. Table 5-2 (page 5-5) contains criteria for bargecarring ships that are not in use.

Because of the many possible variables in this type of an operation, the given situation must be evaluated instead of using a simple formula. Factors that must be considered include the following:

- ❑ Number of barges required daily at the ORP.
- ❑ Number of barges required daily at the IWWT.
- ❑ Number of barges in transit daily on the IWWS.
- ❑ Frequency of berth vacant time at the ORP.
- ❑ Length of berth vacant time at the ORP.
- ❑ Maintenance factor for barges.
- ❑ Surge for barges for peak periods.

IWWT Capacity

Appropriate terminal service units or teams staff inland waterway terminals. The number of units required depends on the results of an IWWT throughput analysis. An analysis is conducted for each IWWT in the IWWS. The combined capacity of the IWWTs is the cumulative total of the restricting capacity (reception capacity, discharge capacity, or clearance capacity) for each IWWT. There may be a requirement for tugboats stationed at the IWWTs to make up/breakup tows and to shift barges between terminals and an additional mooring area. The additional mooring area may be required to allow a buildup of barges to keep an even flow of barges at the terminals.

Table 5-1. Determining factors when using barge-carrying ships

FACTORS	
• Terminal workdays devoted to shipload of cargo: $G = \frac{D}{A^*} \frac{E}{B^*} \frac{F}{C}$	• Number of tugboats required to deliver tows: $Q = \frac{K + a}{M}$
• Barges required at the IWWT daily: $H = \frac{J}{G}$	• Transit time for tugboats: $R = \frac{S + T + U + W}{V}$
• Number of tows required at the IWWT daily: $K = \frac{H}{L}$	• Turnaround time for a tugboat in hours: $P = 2R$
• Number of tows one tug can deliver daily: $M = \frac{N}{P}$	• Turnaround time for shipload of barges: $Y = Z + G + P$

LEGEND:

A = IWWT daily discharge rate for containers

B = IWWT daily discharge rate for general cargo

C = IWWT daily discharge rate for heavy containers

D = total containers on shipload of barges

E = total general cargo on shipload of barges

F = total heavy lifts on shipload of barges

G = IWWT workdays devoted to shipload of barges

H = barges required at the IWWT daily

J = total number of barges on shipload

K = number of tows required at the IWWT daily

L = number of barges per tow

M = number of tows one tug can deliver per day

N = operational hours per day

P = turnaround time for a tugboat in hours

Q = number of tugboats required to deliver tows

R = transit time for tugboats

S = time to makeup a tow of barges and tugboat

T = traverse time of locks

U = distance from ORP to IWWT

V = average speed of tows

W = time to break up a tow of barges and secure

Y = turnaround time for shipload of barges

Z = ship discharge and processing time of first and last tow

a = maintenance factor for tugboats

Table 5-2. Determining factoring when not using barge-carrying ships

FACTORS	
• Daily barge loading rate at the ORP: $A = B \times C$ • Barges loaded daily at the ORP: $D = \frac{A}{E}$ • Daily barge requirement at the ORP: $F = D + G$ • Daily barge discharge rate of the IWWT: $H = J \times K$ • Barges discharged daily at the IWWT: $L = \frac{H}{E}$ • Daily barge requirement at the IWWT: $M = L + G$	• Daily tows required at the ORP: $N = \frac{F}{Q}$ • Daily tows required at the IWWT: $P = \frac{M}{Q}$ • Turnaround time of tugboat: $R = 25$ • Number of tows a tugboat can deliver daily: $T = \frac{U}{R}$ • Number of tugboats required to deliver tows: $V = \frac{N \text{ or } P^*}{T + W}$ • Number of barges required for the IWWS.

LEGEND:

A = daily barge-loading rate at the ORP
B = number of barge-loading berths at the ORP
C = daily loading rate per barge berth at the ORP
D = barges loaded daily at the ORP
E = average barge cargo capacity
F = daily barge requirement at the ORP
G = barge maintenance factors (round up)
H = daily barge discharge rate at the IWWT
J = number of barge discharge berths at the IWWT
K = daily discharge rate per barge berth at the IWWT
L = barges discharged daily at the IWWT
M = daily barge requirement at the IWWT
N = daily tows required at the ORP
P = daily tows required at the IWWT
Q = barges per tow
R = turnaround time of a tugboat in hours
S = transit time for tugboat
T = number of tows a tugboat can deliver daily
U = operational hours per day
V = number of tugboats required to deliver tows
W = tugboat maintenance factor (round up)
Y = number of barges required for the IWWS

*largest of the two (N or P)

IWWS Capacity

After estimating the capacity of the three functional components of the IWWS, the least of the three capacities is used as the estimated capacity for the entire system (see Table 5-3). Once the capacity of the IWWS has been determined, personnel requirements for each component of the IWWS can be determined. If HN personnel are to support part of the IWWS, only the US Army personnel augmentation must be determined. If the capacity does not meet the requirements, adjustments can usually be implemented.

To determine equipment needed to support the IWWS, the planner must first determine the numbers and capabilities of barges and tugs that the HN will allocate to the US Army. This will allow determination of the US Army equipment augmentation requirement. Numbers of barges and tugs to support the IWWS can be computed by using the formulas given in this chapter.

During hours of darkness, an expanded use of radars is normally required. Searchlights and floodlights are also of great assistance. Operational radars should be on all vessels and at terminals and bridges as well as at locks. Expanded use of radars and lights should be carefully weighed during blackout conditions as these systems have a greater vulnerability to enemy detection and attack.

Ocean Reception Point

An ORP consists of mooring points for ships, a marshaling area for barges or other lighterage, and a control point. At least two stake barges should be at each ORP, one for import cargo and one for export cargo. LASH, SEABEE, container, and general cargo vessels may discharge at an ORP. Because of the rapid discharge capability of LASH and SEABEE vessels, the ORP should have enough berthing to handle twice the barge capacity of these type of ships. Under the stake barge system, it should have water space with enough stake barges to accommodate the same amount of barges as the wharf space. Barges can be of the preloaded variety, such as those discharged from LASH and SEABEE vessels, or they can be barges or other lighterage loaded from container or general cargo vessels. In either instance, there must be enough wharfage or stake barge space to handle barges from the current working ships as well as returning empty barges from previous working vessels.

The reception capacity, discharge capacity, and clearance capacity of an ORP are computed the same as for a marine terminal with a few minor differences. ORP clearance capacity is the number of personnel, containers, barges, or STONs of cargo that can be moved from the ORP via any mode. Terminal transfer and storage capacity influences terminal discharge capacity. Tugs and barges (terminal transfer) and wharfs or stake barges (storage) also influence ORP discharge capacity. Careful analysis must be made to determine the space required and available for stake barges and space required to move barges to and from the stake barges. Transit time between the ship and the stake barge or wharf and other factors incidental to cargo, barge, and/or lighterage transfer and storage must also be determined.

Table 5-3. Daily IWWS capacity

ORP	INLAND WATERWAY	INLAND WATERWAY TERMINAL
3,000 tons	2,000 tons	2,500 tons